



U.S. Department of Energy

Categorical Exclusion Determination Form

Submit by E-mail

Proposed Action Title: Arizona State University (ASU) - Cyanobacteria Designed for Solar-Powered Highly Efficient Production of Biofuels - Phase II

Program or Field Office: Advanced Research Projects Agency - Energy

Location(s) (City/County/State): Tempe, AZ

Proposed Action Description:

Proposed work consists of the fabrication and operation of a photobioreactor system on the roof of a laboratory facility on the ASU campus in Tempe, AZ. The proposed photobioreactor system will be operated within a plastic enclosure. ASU will comply with NIH Guidelines for Research Involving Recombinant DNA Molecules when carrying out the proposed activities.

Categorical Exclusion(s) Applied:

B3.6 - Small-scale research and development, laboratory operations, and pilot projects

For the complete DOE National Environmental Policy Act regulations regarding categorical exclusions, including the full text of each categorical exclusion, see Subpart D of [10 CFR Part 1021](#).

Regulatory Requirements in 10 CFR 1021.410(b): (See full text in regulation)

The proposal fits within a class of actions that is listed in Appendix A or B to 10 CFR Part 1021, Subpart D.

To fit within the classes of actions listed in 10 CFR Part 1021, Subpart D, Appendix B, a proposal must be one that would not: (1) threaten a violation of applicable statutory, regulatory, or permit requirements for environment, safety, and health, or similar requirements of DOE or Executive Orders; (2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment facilities (including incinerators), but the proposal may include categorically excluded waste storage, disposal, recovery, or treatment actions or facilities; (3) disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that preexist in the environment such that there would be uncontrolled or unpermitted releases; (4) have the potential to cause significant impacts on environmentally sensitive resources, including, but not limited to, those listed in paragraph B(4) of 10 CFR Part 1021, Subpart D, Appendix B; (5) involve genetically engineered organisms, synthetic biology, governmentally designated noxious weeds, or invasive species, unless the proposed activity would be contained or confined in a manner designed and operated to prevent unauthorized release into the environment and conducted in accordance with applicable requirements, such as those listed in paragraph B(5) of 10 CFR Part 1021, Subpart D, Appendix B.

There are no extraordinary circumstances related to the proposal that may affect the significance of the environmental effects of the proposal.

The proposal has not been segmented to meet the definition of a categorical exclusion. This proposal is not connected to other actions with potentially significant impacts (40 CFR 1508.25(a)(1)), is not related to other actions with individually insignificant but cumulatively significant impacts (40 CFR 1508.27(b)(7)), and is not precluded by 40 CFR 1506.1 or 10 CFR 1021.211 concerning limitations on actions during preparation of an environmental impact statement.

Based on my review of the proposed action, as NEPA Compliance Officer (as authorized under DOE Order 451.1B), I have determined that the proposed action fits within the specified class(es) of action, the other regulatory requirements set forth above are met, and the proposed action is hereby categorically excluded from further NEPA review.

NEPA Compliance Officer:

Date Determined: 10/16/2012



U.S. Department of Energy Categorical Exclusion Determination Form

Submit by E-mail

Proposed Action Title: (25A5144) Arizona State University - Cyanobacteria Designed for Solar-Powered Highly Efficient Production of Biofuels - Phase II

Program or Field Office: Advanced Research Projects Agency - Energy

Location(s) (City/County/State): Tempe, AZ; Mesa, AZ; Gilbert, AZ; St. Paul, MN; Raleigh, NC

Proposed Action Description:

Funding will support (1) engineering and optimization of the cyanobacteria *Synechocystis* to enhance the organism's ability to produce laurate, a fatty acid capable of conversion to biofuel, in a wide variety of environmental conditions, and (2) the design and development of a large-scale, low-flow photobioreactor system that can harvest cyanobacteria for production of laurate.

Proposed work consists of indoor laboratory and greenhouse-based research and development (R&D), including (1) genetically engineering *Synechocystis* to improve laurate productivity over a larger range of environmental conditions, (2) small-scale, laboratory-based cultivation of *Synechocystis* to demonstrate stability of laurate, (3) development of laurate harvest and recovery protocols, (4) development and optimization of small-scale photobioreactors designed for cultivation of photosynthetic *Synechocystis* and recovery of laurate produced by the *Synechocystis*, (5) natural sunlight testing and validation of small-scale photobioreactor units to test efficiency of laurate recovery, (6) design, development, and optimization of a large-scale Smart Flow photobioreactor system designed for cultivation of photosynthetic *Synechocystis* and recovery of laurate produced by the *Synechocystis*, (7) natural sunlight testing and validation of the large-scale photobioreactor system in contained greenhouses to test efficiency of laurate recovery, and (8) laboratory-based conversion of laurate into jet fuel using laurate produced from the large-scale Smart Flow photobioreactor system. R&D tasks will be conducted in dedicated university laboratory and greenhouse facilities located at Arizona State University (Tempe, AZ; Mesa, AZ), University of Minnesota (St. Paul, MN), and North Carolina State University (Raleigh, NC). Supportive engineering and techno-economic analysis will be performed at Diversified Energy Corp.

Categorical Exclusion(s) Applied:

B3.6 - Small-scale research and development, laboratory operations, and pilot projects

A9 - Information gathering, analysis, and dissemination

For the complete DOE National Environmental Policy Act regulations regarding categorical exclusions, including the full text of each categorical exclusion, see Subpart D of 10 CFR Part 1021.

Regulatory Requirements in 10 CFR 1021.410(b): (See full text in regulation)

The proposal fits within a class of actions that is listed in Appendix A or B to 10 CFR Part 1021, Subpart D.

To fit within the classes of actions listed in 10 CFR Part 1021, Subpart D, Appendix B, a proposal must be one that would not: (1) threaten a violation of applicable statutory, regulatory, or permit requirements for environment, safety, and health, or similar requirements of DOE or Executive Orders; (2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment facilities (including incinerators), but the proposal may include categorically excluded waste storage, disposal, recovery, or treatment actions or facilities; (3) disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that preexist in the environment such that there would be uncontrolled or unpermitted releases; (4) have the potential to cause significant impacts on environmentally sensitive resources, including, but not limited to, those listed in paragraph B(4) of 10 CFR Part 1021, Subpart D, Appendix B; (5) involve genetically engineered organisms, synthetic biology, governmentally designated noxious weeds, or invasive species, unless the proposed activity would be contained or confined in a manner designed and operated to prevent unauthorized release into the environment and conducted in accordance with applicable requirements, such as those listed in paragraph B(5) of 10 CFR Part 1021, Subpart D, Appendix B.

There are no extraordinary circumstances related to the proposal that may affect the significance of the environmental effects of the proposal.

The proposal has not been segmented to meet the definition of a categorical exclusion. This proposal is not connected to other actions with potentially significant impacts (40 CFR 1508.25(a)(1)), is not related to other actions with individually insignificant but cumulatively significant impacts (40 CFR 1508.27(b)(7)), and is not precluded by 40 CFR 1506.1 or 10 CFR 1021.211 concerning limitations on actions during preparation of an environmental impact statement.

Based on my review of the proposed action, as NEPA Compliance Officer (as authorized under DOE Order 451.1B), I have determined that the proposed action fits within the specified class(es) of action, the other regulatory requirements set forth above are met, and the proposed action is hereby categorically excluded from further NEPA review.

NEPA Compliance Officer:

Date Determined: 04/17/2012



U.S. Department of Energy

Categorical Exclusion Determination Form

Program or Field Office: Advanced Research Projects Agency - Energy (ARPA-E)

Project Title: 25A5144 - Cyanobacteria Designed for Solar-Powered Highly Efficient Production of Biofuels

Location: *- Multiple States - Arizona, North Carolina

Proposed Action or Project Description:

American Recovery and Reinvestment Act:

The transformative concept of this research program is to use cyanobacteria as biocatalysts using solar energy and CO₂ to produce fatty acids that the cyanobacteria secrete, without major increases in cyanobacterial biomass. Fatty acids are then used for fuel production. Therefore, a major part of the absorbed solar energy and fixed CO₂ will be used for fuel production rather than for biomass production, and energy losses are kept to a minimum. This research program will yield a path toward very efficient solar energy conversion to fuel, and at scale will have a significant impact on environmentally responsible, domestic production of liquid transportation fuels. In this project we will utilize metabolic engineering to maximize fatty acid production and secretion in the cyanobacterium *Synechocystis* sp. PCC 6803 and minimize the energy diverted to the growth of the organism by using cultures that ideally are in stationary phase but that remain physiologically competent. Efficient fatty acid production is then partnered with technologies that efficiently transform these fatty acids into liquid transportation fuels. This represents a paradigm shift in biofuels production from photosynthetic microorganisms as the current production mechanism relies on the harvest of the entire organism and the extraction of the lipid content, leaving the non-lipid biomass (the growth product that we seek to eliminate). Our experimentally supported concept, eliminating major biomass production, enables the highly efficient conversion of solar energy into biofuel compatible feedstock with

Categorical Exclusion(s) Applied:

X - B3.6 Siting/construction/operation/decommissioning of facilities for bench-scale research, conventional laboratory operations, small-scale research and development and pilot projects

*-For the complete DOE National Environmental Policy Act regulations regarding categorical exclusions, see Subpart D of 10 CFR10 21 [Click Here](#)

This action would not: threaten a violation of applicable statutory, regulatory, or permit requirements for environment, safety, and health, including DOE and/or Executive Orders; require siting, construction, or major expansion of waste storage, disposal, recovery, or treatment facilities, but may include such categorically excluded facilities; disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; or adversely affect environmentally sensitive resources (including but not limited to those listed in paragraph B.(4)) of Appendix B to Subpart D of 10 CFR 1021). Furthermore, there are no extraordinary circumstances related to this action that may affect the significance of the environmental effects of the action; this action is not "connected" to other actions with potentially significant impacts, is not related to other proposed actions with cumulatively significant impacts, and is not precluded by 40 CFR 1506.1 or 10 CFR 1021.211.

Based on my review of information conveyed to me and in my possession (or attached) concerning the proposed action, as NEPA Compliance Officer (as authorized under DOE Order 451.1B), I have determined that the proposed action fits within the specified class(es) of action, the other regulatory requirements set forth above are met, and the proposed action is hereby categorically excluded from further NEPA review.

NEPA Compliance Officer: /s/ William J. Bierbower

Digitally signed by William J. Bierbower
 DN: cn=William J. Bierbower, o, ou,
 email=william.bierbower@hq.doe.gov, c=US
 Date: 2009.12.18 12:02:46 -05'00'

Date Determined: 12/18/2009

Comments:

Webmaster:



25A5144 – Proposed Action or Project Description

concept, eliminating major biomass production, enables the highly efficient conversion of solar energy into biofuel-compatible feedstock with efficiencies that are expected to be closer to the maximal theoretical limit of 28%. The combination of secretion of fatty acids and eliminating biomass production, yields a much more economical and environmentally responsible path toward biofuel production than can be accomplished by traditional methods. Our proposal for development and optimization of cyanobacteria as photobiocatalysts for solar-powered CO₂ reduction and fuel production represents a critical step forward in the efficient production of renewable biofuels by photosynthetic microorganisms. Cyanobacteria are excellent organisms for the production of carbon-neutral and sustainable biofuel. Unlike the vast majority of algae, the genome of *Synechocystis* is relatively easy to manipulate, and the absence of organellar compartmentation simplifies metabolic engineering efforts. Cyanobacteria are efficient at converting solar energy into lipids, and unlike energy crops, they can be grown on non-arable land. Our team of researchers and collaborators includes Arizona State University with extensive experience in metabolic engineering and physiology of *Synechocystis* as well as in photobioreactor technologies, North Carolina State University with experience in conversion of lipids into gasoline, diesel, and jet fuel, Diversified Energy with experience in developing photobioreactor and translation technologies for renewable photosynthesis-based fuels, and The Dial Corporation, with extensive experience and knowledge in the translation and processing of lipids and fatty acids. This team represents a set of highly competent scientists and engineers that can advance the key technologies required for implementation. This team also offers an early path to market for renewable fatty acid production that may go beyond the biofuels market and that may include production of high-value, renewable fatty acid feedstock for renewable, green personal care products at a reasonable scale. The personal care products market in turn may represent a gateway industry to advance the systems development and optimization required for the ultimate biofuels market that operates at much larger scale. In this way, responsible and economically feasible scale-up to levels that may significantly impact transportation fuel markets may be accomplished.